

INDOOR AIR QUALITY ASSESSMENT

**Lt. Peter M. Hansen Elementary School
25 Pecunit Street
Canton, MA**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
July 2018

Background

Building:	Lt. Peter M. Hansen Elementary School
Address:	25 Pecunit Street, Canton, MA
Assessment Requested by:	Canton Public School Department and Canton Teacher's Union
Reason for Request:	Concerns about indoor air quality (IAQ) and chronic illness
Date of Assessment:	January 26, 2018
Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) Staff Coordinating/Conducting Assessment:	Cory Holmes, Environmental Analyst/Inspector, IAQ Program and Erin Collins, Epidemiologist, Community Assessment Program (CAP)
Building Description:	A multi-level concrete and brick building with a flat roof.
Year Built:	Originally constructed in the late 1960s; a second wing was added in 2016.
Building Population:	The school houses a student population of approximately 475 and a staff of approximately 60.
Windows:	Openable, replaced approximately three years ago.

Methods

Please refer to the IAQ Manual for methods, sampling procedures, and interpretation of results (MDPH, 2015).

IAQ Testing Results

The following summarizes indoor sampling results at the time of assessment (Table 1).

- *Carbon dioxide levels* were above 800 parts per million (ppm) in the majority of areas tested (41 of 44), which is explained further in the *Ventilation* section of this report. MDPH recommends that carbon dioxide levels be maintained at 800 ppm or below. This is because most environmental and occupational

health scientists involved with research on IAQ and health effects have documented significant increases in IAQ complaints and/or health effects when carbon dioxide levels rise above the MDPH guideline of 800 ppm for schools, office buildings and other occupied spaces (Sundell et al., 2011).

- **Temperature** was within or very close to the recommended range of 70°F to 78°F in all areas tested the day of assessment. However, several staff expressed issues with temperature/comfort control. It is important to note that thermal comfort conditions vary greatly among individuals and it is challenging to set a temperature that can satisfy everyone, particularly in a public/school building. As a general rule, optimum temperatures would achieve 80% occupant acceptability (ASHRAE 2004).
- **Relative humidity** was below the recommended range of 40 to 60% in the areas tested which is typical of New England during the heating season. Low relative humidity can lead to common symptoms such as: dry skin, lips, and scalp; dry/scratchy throats and noses (nose bleeds); exacerbation of asthma, eczema, or allergies; dry/irritated eyes; and irritation of respiratory tract.
- **Carbon monoxide** levels were non-detectable (ND) in all areas tested.
- **Fine particulate matter (PM_{2.5})** concentrations measured were below the National Ambient Air Quality Standard (NAAQS) level of 35 µg/m³ in all areas tested.
- **Total Volatile Organic Compounds (TVOCs)** levels were ND in areas tested.

Ventilation

A heating, ventilating, and air conditioning (HVAC) system has several functions. First it provides heating and, if equipped, cooling. Second, it is a source of fresh air. Finally, an HVAC system will dilute and remove normally occurring indoor environmental pollutants by not only introducing fresh air, but by filtering the airstream and ejecting stale air to the outdoors via exhaust ventilation. As previously mentioned, carbon dioxide measurements were elevated in the majority of areas the day of assessment; this is likely for several reasons:

- *Limited outside air introduction:* The temperature on the day of assessment was below freezing ($< 32^{\circ}\text{F}$), outside air is typically limited during extreme cold to prevent the freezing of pipes, which can result in flooding and damage to HVAC equipment/building materials. Dampers may be able to be adjusted (Figure 1) to provide more fresh air during more temperate weather;
- *Age and condition of HVAC equipment:* The HVAC units are original to the building's construction (~ 50 years old). According to the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), the service life for a unit heater, hot water or steam is 20 years, assuming routine maintenance of the equipment (ASHRAE, 1991). Despite attempts to maintain the univents (e.g., oiling bearings, changing filters regularly), the operational lifespan of this equipment has been exceeded. Maintaining the balance of fresh to exhaust air will become more difficult as the equipment ages and as replacement parts become increasingly difficult to obtain; and
- *Design of HVAC equipment/room configuration:* Both the supply and the exhaust unit in the 1960s building are on the same/exterior wall, which prevents circulation to the interior side of the room (Figure 2). In addition, these units operate independently to each other and intermittently during the day. The MDPH recommends that both supply and exhaust operate *continuously* during occupied periods to provide air circulation/filtration.

Fresh air in classrooms is supplied by unit ventilator (univent) systems (Picture 1). A univent draws air from outdoors through a fresh air intake located on the exterior wall of the building (Picture 2) and returns air through an air intake located at the base of the unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through an air diffuser located in the top of the unit. In a number of classrooms, items placed on and/or in front of univents were obstructing normal airflow (Pictures 3 and 4).

Exhaust ventilation for classrooms in the 1960s portion of the building is provided by unit exhaust ventilators (Picture 5). These units look similar to univent cabinets but have a motor inside to draw air *out* of the room via a grill located at floor level and through a vent on the exterior of the building (Picture 2). As mentioned, these units are

~50 years old and were operating sporadically during the assessment. In addition, many were being used as shelves and were obstructed by various items, limiting airflow (Picture 5).

Exhaust ventilation for classrooms in the 2016 addition is provided by ceiling vents ducted to rooftop motors. The location of some exhaust vents (i.e., above the hallway door) can limit exhaust efficiency (Picture 6). If doors are left open, the vents will tend to draw air from the hallway *into* the classroom instead of stale air and airborne pollutants *out* of the classroom as designed.

Mechanical ventilation in interior rooms and common areas (e.g., gym) is provided by rooftop or ceiling-mounted air-handling units (AHUs, Picture 7). Fresh air is distributed via ceiling-mounted air diffusers and ducted back to AHUs via ceiling or wall-mounted return vents. The AHU in the gym was not operating at the time of assessment. These units should run during occupied periods.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing of the HVAC system for the 1960s building was not available at the time of the assessment. Balancing of the HVAC system for the 2016 building should have occurred prior to occupancy.

Microbial/Moisture Concerns

It was reported that the roof was replaced over the summer of 2017. Water-damaged ceiling tiles were observed in the 5th grade hallway and a few other areas (Picture 8; Table 1), which may be historic evidence of leaks. Tiles should be replaced once leaks are found and repaired.

In a few areas outside the building, plants/shrubs were observed in close proximity to exterior walls/HVAC vents, which can hold moisture against the side of the building and lead to deterioration as well as damage due to root infiltration. In addition,

nearby plants can be a source of pollen and debris which can clog univent filters and infiltrate through open windows. It was clear that school maintenance staff had made efforts to trim these shrubs away from direct contact.

Many areas contained air conditioners (ACs); some were portable floor-based units and some were window-mounted or wall-mounted (Picture 9). These units have condensation drains, which may become clogged and leak if they are not maintained. The AC unit in classroom 110 was examined and the drainage tube was excessively long, which may be easily damaged and is likely to lead to clogs and stagnant water (Picture 10).

Indoor plants were observed in several areas (Table 1). Plants, soil, and drip pans can serve as sources of mold/bacterial growth. Plants should be properly maintained, over-watering of plants should be avoided, and drip pans should be inspected periodically for mold growth. In addition, plants should not be placed on top of or in the airstream of HVAC equipment such as univents.

Volatile Organic Compounds (VOCs)

Exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat, and/or respiratory irritation in some sensitive individuals. To determine if VOCs were present, BEH/IAQ staff measured TVOCs in the areas assessed; no measureable levels were observed. Good ventilation is required to remove irritants from cleaning chemicals and other sources of TVOCs. BEH/IAQ staff also examined rooms for products containing VOCs. BEH/IAQ staff noted hand sanitizers, cleaners, air deodorizers and dry erase materials in use within the building (Table 1). All of these products have the potential to be irritants to the eyes, nose, throat, and respiratory system of sensitive individuals. Photocopiers and laminators were located in the teacher work rooms. Photocopiers can emit ozone and TVOCs, especially when they are older or heavily used, laminators give off waste heat and plastic odors.

Other IAQ Evaluations

Other conditions that can affect IAQ were observed during the assessment. The MDPH recommends pleated filters with a Minimum Efficiency Reporting Value

(MERV) of 8, which are adequate in filtering out pollen and mold spores (ASHRAE, 2012). Filters should also be changed two to four times a year, or per the manufacturer's recommendations. BEH/IAQ staff examined univent filters, which appear to be a mid-grade/mesh-type (Picture 11) that are reportedly MERV 8 and changed twice a year (i.e., Christmas/summer vacations).

Many classrooms had personal fans. Some of these had dusty blades (Picture 12; Table 1). Some supply and exhaust vents were also observed to be dusty. This dust can be reaerosolized when the equipment is activated. In many areas, items, including books, papers, toys and decorative items were observed on floors, windowsills, tabletops, counters, bookcases, and desks (Pictures 3, 4 and 5), which can make it more difficult for custodial staff to clean.

Several areas contained carpeting. The usable life of carpeting in schools is approximately 10-11 years (IICRC, 2002). Aging carpet can produce fibers that can be irritating to the respiratory system. In addition, tears or lifting carpet can create tripping hazards. Carpeting should be cleaned annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC, 2012). Most classrooms had area rugs, which should also be cleaned regularly and discarded when too worn out or soiled to be cleaned.

Chronic urine odors were reported in the restroom within classroom 110. BEH/IAQ checked the ceiling-mounted exhaust vent, which appeared to be either not drawing or very weak. In addition, the floor contained a drain, which may have a dry trap. If drains are not kept wet, the drain traps will dry out and allow gases from the sewer to penetrate into occupied spaces. Floor drains should be kept wet by having water poured into them periodically.

Occasional exhaust fumes from gas powered maintenance equipment (e.g., snow blowers, lawn mowers) were reported in the gym/office area. Maintenance personnel should ensure equipment is fully outside the building prior to operating, to avoid occupant exposure to exhaust fumes and particulates.

The occupant in classroom 110 had concerns of black particles/debris periodically coming from the univent. This could be the result of dust/debris accumulation within the unit, breakdown of insulation/sound-proofing material or the drawing in of outside debris

particulates bypassing filters. BEH/IAQ staff recommends that any loose/damaged insulation/sound-proofing material within the unit be removed and that the unit be thoroughly “blown out” with pressurized air and/or the cabinet and all internal components be vacuumed with a HEPA-filtered vacuum cleaner. No dust/debris was observed emanating from the unit during operation at the time of assessment. While the reported particles may be unsightly and require regular cleaning, no elevated levels of airborne PM2.5 were found during the assessment. However, loose fiberglass (pink) insulation was observed in the univent cabinet (Picture 13), which can provide a source of skin, respiratory and eye irritation.

Radon

Note that the Environmental Protection Agency (EPA) conducted a National School Radon Survey in which it discovered nearly one in five schools had “...at least one frequently occupied ground contact room with short-term radon levels above 4 [picocuries per liter] pCi/L” (US EPA 1993). The BEH/IAQ Program therefore recommends that every school be tested for radon, and that this testing be conducted during the heating season while school is in session in a manner consistent with USEPA radon testing guidelines. Radon measurement specialists and other information can be found at www.nrsb.org and <http://aarst-nrpp.com/wp>, with additional information at: <http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/iaq/radon>.

In 2016 an environmental consultant, FLI Environmental, was contracted to conduct limited radon testing. According to the FLI report, all levels were found to be below EPA recommendations and no further actions were required (FLI, 2016). However, what appears to be a passive radon mitigation system was installed outside room 101 (Picture 14).

Health Concerns

At the request of administrators of the Canton Public Schools, BEH staff from the Community Assessment Program (CAP) and the Indoor Air Quality Program (IAQ) attended a meeting on April 25, 2017 with several teachers of the Canton Public Schools

who had health and building concerns. This meeting was also attended by their Union Representative and representatives of the Massachusetts Teachers Association as well as the Superintendent and Business Administrator for Canton Public Schools. In response to the specific concerns that were raised at the meeting, the Luce Elementary School and the Hansen Elementary School were identified as priorities. (A report for the Luce Elementary School was issued in September 2017). CAP staff conducted in-person interviews with interested employees of the Hansen Elementary School on January 26, 2018 and also offered to conduct interviews over the phone for those unable to attend on that day. IAQ staff conducted an indoor air quality assessment of the building the same day.

The interviews included the administration of a questionnaire by BEH/CAP staff to obtain information on the type and frequency of symptoms experienced by some employees. The questionnaire was closely modeled on surveys used previously by BEH as well as those used by the National Institute of Occupational Safety and Health (NIOSH) and the U.S. Environmental Protection Agency (US EPA). The questionnaire elicited information on specific symptoms that have been reported in the scientific/medical literature as commonly experienced by occupants of buildings with indoor air quality problems as well as information on perceived air quality and personal health factors. These types of questionnaires are used to systematically collect building-related health and environmental complaints. The information collected, in conjunction with the assessment of the indoor environment, can be used to evaluate possible associations between indoor air quality and health and to recommend appropriate follow-up, if warranted.

The Hansen Elementary School has an employee population of approximately 60 individuals. Five current employees (8%) participated in the BEH interview. All responses were reviewed to identify the types of diseases and symptoms that were reported, their frequency of occurrence, and whether any unusual patterns emerged suggestive of a possible association with indoor environmental conditions at the school.

Employee Interview Results

A total of five current employees participated in the interviews. Due to the small number of participants, limited information about health effects and indoor air quality concerns experienced within the last 4 weeks (of the time of the interview) and additional health and building related concerns was collected. Under both state and federal regulations, personally-identifying information shared by employees is confidential; therefore, the following discussion provides summary information only.

Health Effects

The average age of the five employees who participated in the interviews was approximately 42 years old and the average length of employment at the school was 12 years. Smoking status was obtained in the interviews due to the role of smoking in respiratory health.

The most commonly reported symptoms (with at least three of the five employees reporting that they experienced the symptom at least once in the four weeks prior to the interview) were sore, hoarse, or dry throat; headaches; pain or stiffness in the neck, shoulders, or back; and difficulty remembering things or concentrating. Respondents were asked if they experienced these symptoms primarily inside the building, outside the building, or both. The majority of the employees who reported experiencing headaches or sore throat reported experiencing these symptoms mostly inside the building. There was no majority response for employees who reported pain or stiffness in the neck, shoulders, or back or difficulty remembering things or concentrating. Respondents were asked if there was a particular time of day or week when their symptoms became worse or occurred more frequently. Overall, there did not appear to be a consistent pattern among respondents with most employees reporting no observable pattern over the course of a week, and identifying different times of day when their symptoms seemed worse.

Concerned employees were also asked if they had been diagnosed by a doctor with any of the following conditions: asthma, eczema, hay fever, or migraine headaches. Of these conditions, at least one employee had been diagnosed with at least one of the following: asthma, hay fever, or eczema.

The employees who participated in the interviews were asked if they had any other health-related concerns at the Hansen Elementary School that had not yet been discussed. Concerns were raised about the incidence of cancer among current and past employees, and the incidence of pneumonia among students and staff.

Building Concerns

BEH/CAP staff also asked employees several questions about their perceptions of environmental conditions in their work surroundings. The most commonly reported conditions as reported by at least three of the five employees were unusual dusts and the air was too stuffy. Most employees noted that conditions within the building varied depending on the season, and that some things such as extreme temperatures were worse during particular times of the year.

All employees who participated in the interviews were asked if they had any other building-related concerns at the Hansen Elementary School that had not yet been discussed. A variety of concerns were raised, including the following:

- Radon testing and mitigation systems.
- Inadequate ventilation in bathroom areas.
- Inadequate ventilation in the copy room.
- Inadequate air circulation due to the design of the windows in the building.
- Inconsistency in temperatures in different areas of the building.
- High levels of humidity throughout the building at certain times of the year.

Symptomology and Building Location

The locations where individuals reported working in the building and their health concerns were evaluated with respect to the results from the environmental testing conducted by BEH/IAQ staff. All employees reported that there were specific locations within the building where they spend the majority of their time. All individuals reported working primarily in one location throughout the course of a given day.

Health Discussion

The respiratory/irritant and other symptoms reported among participants in this health investigation are generally those most commonly experienced in buildings with indoor air quality problems. These included sore, hoarse, or dry throat and headaches. Such symptoms are commonly associated with ventilation problems in buildings, although other factors (e.g., odors, microbiological contamination) may also contribute (Passarelli, 2009; Norbäck, 2009; Burge, 2004; Stolwijk, 1991).

The majority of areas tested during BEH's inspection on January 26th had carbon dioxide levels above the recommended limit of 800 parts per million (41 of the 44 areas that were tested). Indoor air quality complaints and health effects occur more frequently in buildings with carbon dioxide levels above this value. High levels of carbon dioxide have been associated with headaches and impaired decision-making performance (Norbäck and Nordström, 2008; Satish et al., 2012). This may have been a contributing factor for those participants who reported headaches and/or difficulty remembering things or concentrating.

All of the areas tested had relative humidity levels below the recommended range of 40 – 60%, which is common during the winter months in New England. Low relative humidity combined with suboptimal fresh air supply can result in irritant symptoms of eye, nose, throat and skin. Temperature was within or very close to the recommended range of 70-74 degrees Fahrenheit in all areas tested.

Results from environmental sampling indicate a number of opportunities for exposure to allergens, i.e., potential mold growth from water damage and dust. Given that exposure to excessive dust and mold can exacerbate pre-existing symptoms (e.g., asthma, allergies), it is possible that some individuals may react to mold and excessive dust differently than the general population. Allergic responses include hay fever type symptoms such as runny nose and red eyes. It is important to note that the onset of allergic reaction to triggers such as mold/moisture can be either immediate or delayed.

Cancer Concerns

Concerns about cancer, particularly breast cancer, were raised by many of the individuals who attended the initial meeting on April 25, 2017 and by at least one

individual interviewed on January 26, 2018. According to the American Cancer Society, 1 out of 3 people will develop cancer during their lifetime (ACS 2018). For this reason, cancers often appear to occur in “clusters,” and it is understandable that someone may perceive that there are an unusually high number of cancer diagnoses in their neighborhood, workplace or town. Upon close examination, many of these “clusters” are not unusual increases, as first thought, but are related to such factors as local population density or a concentration of individuals who possess related behaviors or risk factors for cancer. Some, however, are unusual; that is, they represent a true excess of cancer in a workplace, a community, or among a subgroup of people. A suspected cluster is more likely to be a true cancer cluster if it involves a high number of diagnoses of one type of cancer in a relatively short time period rather than several different types diagnosed over a long period of time (i.e., 20 years), a rare type of cancer rather than common types, and/or a large number of diagnoses among individuals in age groups not usually affected by that cancer. These types of clusters may warrant further public health investigation.

The Massachusetts Cancer Registry (MCR), a division in the MDPH Office of Data Management and Outcomes Assessment, is a population-based surveillance system that has been monitoring cancer incidence in the Commonwealth since 1982. All new diagnoses of invasive cancer, along with several types of in situ (localized) cancer, occurring among Massachusetts residents are required by law to be reported to the MCR within six months of the date of diagnosis (M.G.L. c.111. s 111b). This information is collected and kept in a confidential database. Data are collected and reviewed for accuracy and completeness. Individuals diagnosed with cancer in Massachusetts are reported to the MCR based on their residence at diagnosis and not their workplace. For that reason, calculating an expected rate of cancer is difficult at best for a place of employment, such as a school. The most practical first step in evaluating cancer in the workplace is to determine the types of cancer reported and whether they represent an unusual pattern.

In Massachusetts, breast cancer has been the most common type of cancer diagnosed among female residents for more than a decade. During 2010 - 2014, this cancer type accounted for approximately 30% of new cancer diagnoses among females in the Commonwealth (MCR 2017). The chance of developing invasive breast cancer at

some time in a woman's life is about 1 in 8 (12%). A woman's risk of developing breast cancer increases with age, with age being the strongest risk factor for breast cancer. Most breast cancers are found in women age 55 and older (ACS 2017). Several studies have found that women who work in professional jobs tend to have an increased risk of developing breast cancer (Ruben et al. 1993; Threlfall et al., 1985; MacArthur et al., 2007; King et al., 1994; Pollan and Gustavsson, 1999) while other studies have not (Calle et al., 1998; Petralia et al., 1999). No occupational exposures have been identified in these studies. Rather, researchers suspect that established risk factors for breast cancer such as later maternal age at first birth and lower parity (the number of times a woman has given birth) may be more prevalent in women working in a professional setting than in women who do not (such as homemakers). A more detailed discussion of breast cancer risk factors can be found in Appendix A.

Many cancers occur because of changes to cells that happen by random chance. These are called sporadic or spontaneous mutations and are not due to any particular exposure to a cancer-causing agent (i.e., carcinogen). Other times, exposure may be an initiating or contributing factor to the development of cancer in an individual. The latency period is the time interval between exposure to a carcinogen and the appearance of symptoms of the disease or its diagnosis. Cancer, in general, has a long latency period but it may vary depending on the type, magnitude, and timing of the exposure. Cancers that are solid tumors, such as breast cancer, are believed to have a long latency period, estimated to be no shorter than 10 years and possibly as long as 50 years or more (Hall 2006; NRC 2005; UNSCEAR 2000; Bang 1996; Frumkin 1995). Due to the long latency period for most types of cancer, it is difficult to identify exposures that may have contributed to an individual's cancer development. It is likely that multiple risk factors influence the development of most cancers. In addition, an individual's risk of developing cancer may change over time and may depend upon a complex interaction between their genetic makeup and exposure to a cancer-causing agent. Or, as previously mentioned, the development of cancer can happen because of a random mutation.

Other Building Concerns

Employees expressed concern about other building conditions, including radon. The U.S. Environmental Protection Agency (EPA) estimates that over 21,000 lung cancer deaths in the U.S. each year are related to radon (USEPA 2018). Radon is the second leading cause of lung cancer in the United States.

Radon is a naturally occurring radioactive gas that is odorless, colorless, and tasteless. As a gas, radon can move through pathways in soil and rock formations. Radon gas decays into microscopic particles that can be inhaled into the lungs. Radon particles trapped in the lungs continue to breakdown, damaging the lung tissue during this decay process. This damage increases the risk of developing lung cancer. Among people who have never smoked, radon is the leading cause of lung cancer.

Radon also increases the chance of lung cancer in people that smoke. For those who are exposed to elevated indoor radon levels, people who smoke have up to 10 times the risk of developing lung cancer than people who have never smoked.

Radon can enter buildings through:

- cracks and crevices in the foundation floors and walls
- floor wall joints
- penetrations of utility lines and sump holes
- private drinking water wells

Radon can build up once inside an enclosed space, such as a home or a school. Most radon gas comes up from the ground, so the amount of radon is likely to be greater in the lowest levels of a building. Radon levels are usually higher in the winter time because, during the heating season, warm air rises and escapes. This creates a vacuum in the lowest part of the building that causes the house to draw air, including radon, from below the building. Any equipment that exhausts air or requires venting can also contribute to the vacuum effect.

Testing the air is the only way to know if indoor radon levels are elevated. MA residents are encouraged to test for radon where they live. The Indoor Air Quality Program's Radon Unit advises and assists homeowners, radon mitigators and owners of public buildings in dealing with high levels of radon in indoor air that contribute unnecessarily to the background radiation received by members of the public. The Radon

Assessment Unit receives funding from the EPA under its State Indoor Radon Grant program to assist in these advisory and mitigation activities.

The Radon Assessment Unit can be reached Monday through Friday from 8:45A.M. to 5:00P.M. at (800) 723-6695 (toll-free in Massachusetts only) or (413) 586-7525.

Conclusions/Recommendations

Health Conclusions

Due to the small number of participants, limited information about health and building related concerns was collected. The symptoms primarily reported among participants in this health investigation (sore, hoarse, or dry throat; headaches) are generally those most commonly experienced in buildings with indoor air quality problems and are commonly associated with ventilation problems in buildings. Difficulty remembering things or concentrating was also a commonly reported symptom among those who participated in this health investigation. It is possible that levels of carbon dioxide above the recommended limit may have been a contributing factor for those participants who reported headaches and/or difficulty remembering things or concentrating.

Although the incidence of cancer among employees of the Hansen Elementary School was a concern expressed by several of those who attended the meeting on April 25, 2017 and by at least one individual interviewed on January 26, 2018, it is important to consider the following:

- Different types of cancer are individual diseases with separate causes and risk factors.
- Cancers in general have long latency or development periods that can range from 10 to 50 years in adults, particularly for solid tumors such as breast cancer.
- A great deal of research has been reported and more is being done to understand possible environmental influences on breast cancer risk. To date, however, there are no established environmental risk factors.

- The development of most cancers is likely influenced by multiple risk factors, while others are due to random changes in cells and occur for no apparent reason.

Indoor Air Quality Conclusions

The following recommendations are made to assist in improving IAQ:

1. Ensure univents and AHUs (i.e., gym) are in operable condition. Operate continuously during occupied periods. Ensure fresh air intake louvers are functioning properly to adjust outside air intake. Make repairs as needed.
2. Ensure unit exhaust ventilators are operable. Determine if they can be programmed, along with univents to run continuously to provide adequate air exchange during occupied periods.
3. Once all AHUs, univents, and exhaust fans are working properly, consider hiring an HVAC engineer to ensure the adequacy of the fresh air supply given the building design and population. Make adjustments accordingly.
4. Given the age/design of HVAC equipment in the original building, consider long-term plans for replacement.
5. Inspect restroom exhaust vents/motors on roof, make repairs as needed (e.g., classroom 110).
6. Remove all items and furniture from the vicinity (~3-5 feet) of univents and exhaust units.
7. Use openable windows to supplement fresh air during temperate weather. Ensure all windows are tightly closed at the end of the day.
8. Create a system for staff to report/log temperature/comfort discrepancies. Make repairs/adjustments to thermostats/HVAC system as needed.
9. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
10. Ensure leaks are repaired and replace any water-damaged ceiling tiles.
11. Indoor plants should be properly maintained and equipped with drip pans to prevent water damage to porous building materials and be located away from

- ventilation sources to prevent the aerosolization of dirt, pollen, or mold. Do not rest plants on porous materials (e.g., cloth, paper).
12. Continue to monitor outdoor plants/shrubs and trim back/away from exterior of building, particularly near HVAC vents.
 13. Ensure that air conditioners drain properly by inspecting hoses for proper length and clogs/leaks periodically. Clean/maintain in accordance with manufacturer's recommendations.
 14. During periods of elevated humidity (i.e., >70 % for extended periods of time), continue to utilize ACs and dehumidifiers as needed. Ensure windows are shut and classroom doors are closed when using these units. All filters and water reservoirs should be cleaned and maintained as per the manufacturer's instructions.
 15. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
 16. Ensure exhaust ventilation is operating in areas with photocopiers and laminators.
 17. Use MERV 8 (or higher) filters in univents and AHUs, if these can be used with the current equipment. Change filters 2-4 times a year, or as manufacture recommends.
 18. Remove loose fiberglass insulation from univent cabinet in classroom 110. Once removed either blow out the unit with high pressured air or vacuum components with a HEPA filtered vacuum cleaner.
 19. Regularly clean/vacuum univent cabinets (e.g., during filter changes), supply/return vents and personal fans to avoid aerosolizing accumulated particulate matter.

20. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
21. Clean window and portable AC filters prior to and periodically/as needed during the cooling season.
22. Reduce the use of air deodorizers, cleaning products, sanitizers, and other products containing VOCs. Consider adopting green cleaning procedures. Ensure cleaning products are properly labeled, and keep material safety sheets on file.
23. Clean carpeting and area rugs annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC, 2012).
24. Replace old worn carpeting past its useful life (> 10-11 years).
25. Pour water down floor drains in restrooms several times a week to prevent dry traps (e.g., classroom 110).
26. Ensure gas-powered maintenance equipment (e.g., snow blowers, lawn mowers) are fully outside the building prior to operating, to avoid occupant exposure to exhaust fumes and particulates.
27. Consider adopting the US EPA (2000) document, “Tools for Schools”, as an instrument for maintaining a good IAQ environment in the building available at: <http://www.epa.gov/iaq/schools/index.html>.
28. Follow-up radon testing, as well as confirmation of mitigation systems operation, should be conducted at the school by a certified radon measurement specialist during the heating season. Radon measurement specialists and other information can be found at: www.nrsb.org, and <http://aarst-nrpp.com/wp/>. Testing criteria should include the following:
 - a. Test all ground contact rooms;
 - b. Test during normal/occupied hours;
 - c. Test during the heating season;
 - d. Test during typical winter temperatures.

29. Refer to resource manual and other related IAQ documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: <http://mass.gov/dph/iaq>.

References

IAQ Assessment Section

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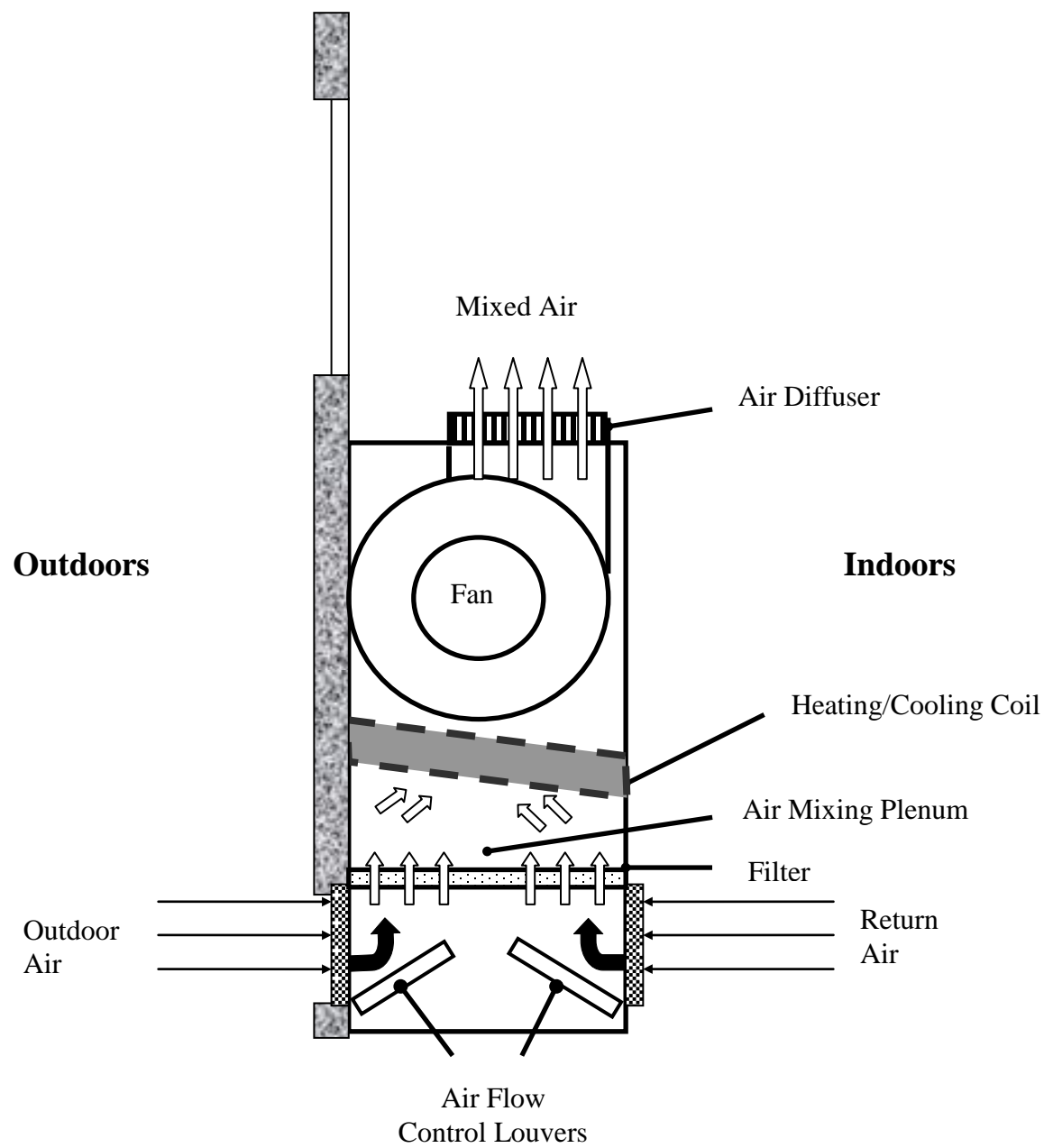
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Figure 1: Unit Ventilator (Univent)

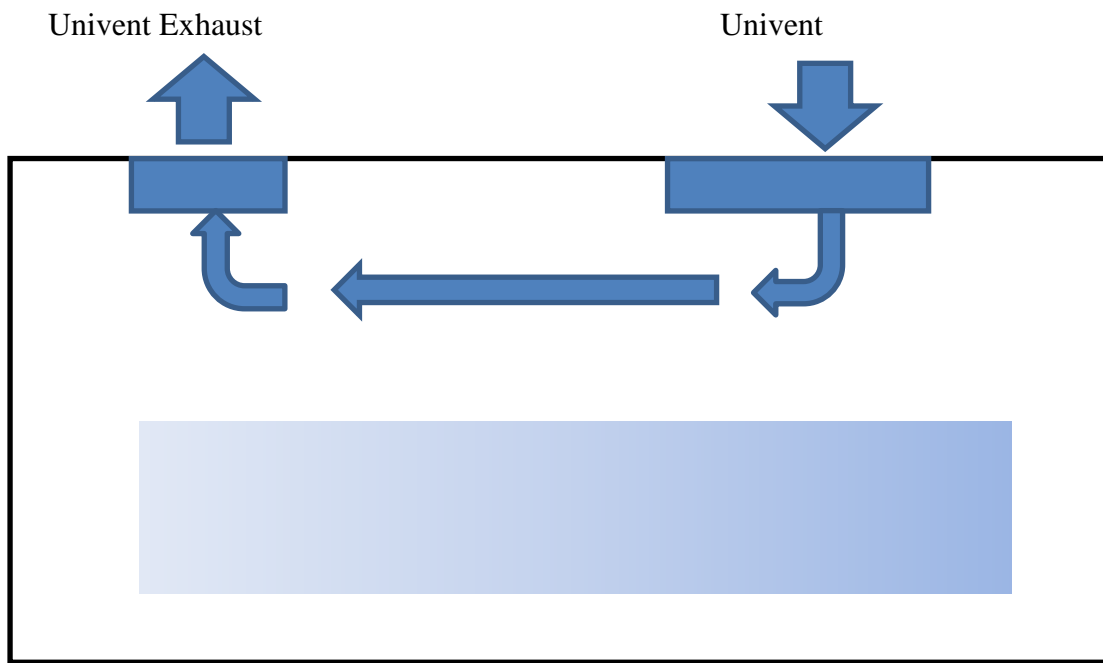


Air Flow

- ← = Fresh air return
- ⇐ = Mixed air

Figure 2

HVAC “Short-Circuiting” limiting air circulation across classroom



Picture 1



Classroom univent

Picture 2



Intake and exhaust vents for univents/unit exhaust ventilators

Picture 3



Items on top/front of univent obstructing airflow

Picture 4



Items on top/front of univent obstructing airflow

Picture 5



Unit exhaust ventilator, note items on top/front obstructing airflow

Picture 6



Proximity of ceiling-mounted exhaust vent near open classroom/hallway door (arrows)

Picture 7



Ceiling-mounted AHU in gym

Picture 8



Water-damaged ceiling tiles in 5th grade hallway

Picture 9



Portable air conditioner (AC)

Picture 10



Drainage tube for AC in classroom 110

Picture 11



Mesh univalent filters

Picture 12



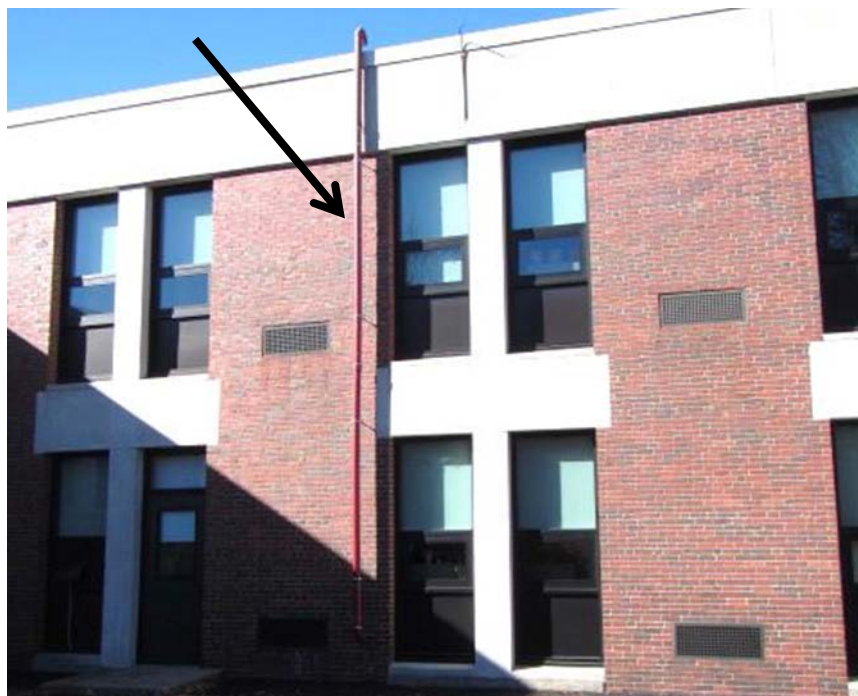
Dust/debris accumulation on fan blades

Picture 13



Loose/pink fiberglass inside univent cabinet in classroom 110

Picture 14



Radon mitigation system (arrow) outside room 101

Location: Lt. Hansen Elementary School

Address: 25 Pecunit Street, Canton, MA

Indoor Air Results

Date: 1/26/2018

Table 1

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	TVOCs (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
Background	398	ND	<32	33	3	ND					Cold, clear, windy
2 nd Floor											
201	1383	ND	73	16	4	ND	20	Y 0/4	Y	Y	
202	1906	ND	72	20	4	ND	18	Y 0/4	Y	Y	Items on/around UV/exhaust unit, missing CT
203	1300	ND	71	18	3	ND	22	Y 0/4	Y	Y	DO, PF
204	1356	ND	72	16	3	ND	24	Y 0/4	Y	Y	
205	993	ND	72	14	5	ND	13	Y 0/4	Y	Y	PF, area rug
206	788	ND	73	10	2	ND	3	Y 0/2	Y	Y	Area rug
5 th Grade Hallway											WD CTs

ppm = parts per million

µg/m³ = micrograms per cubic meter

ND = non-detect

AC = air conditioner

CP = cleaning products

CT = ceiling tile

DO = door open

HS = hand sanitizer

PF = personal fan

TVOCs = total volatile organic compounds

UV = univent

WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 800 ppm = preferable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lt. Hansen Elementary School

Address: 25 Pecunit Street, Canton, MA

Indoor Air Results

Date: 1/26/2018

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	TVOCs (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
207	972	ND	71	11	4	ND	17	Y ¼	Y	Y	Pet mouse, area rug, items on/front UV and exhaust unit
208	1382	ND	72	16	6	ND	18	Y 0/4	Y	Y	PF, DO, HS
209	1703	ND	74	18	4	ND	20	Y 0/4	Y	Y	DO, PF, missing CT
210	792	ND	73	11	4	ND	0	Y 0/4	Y	Y	Occupants at lunch, items on/front UV and exhaust unit, PF
211 Art	1387	ND	77	15	5	ND	1	Y ¼	Y	Y	~20 occupants gone~20 mins
212	1223	ND	75	13	6	ND	2	Y ¼	Y	Y	3 occupants gone ~ 10 mins
213	907	ND	75	10	4	ND	4	Y 2/2	Y	Y	PF, CP
216	1071	ND	75	10	5	ND	21	Y 0/4	Y	Y	Area rug, air deodorizer, exhaust near hallway door

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Indoor Air Results

Date: 1/26/2018

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	TVOCs (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
217	825	ND	72	7	3	ND	18	Y 0/4	Y	Y	Air deodorizer, HS, DO, exhaust near hallway door
First Floor											
101	1496	ND	72	16	4	ND	18	Y 0/3	Y	Y	Items front of UV, area rug, DO, radon mitigation system/pipe, portable AC, HS
102	1315	ND	73	17	3	ND	12	Y 0/4	Y	Y	Items front of UV and exhaust unit, AP, PF, DO
103	925	ND	72	12	3	ND	2	Y 0/3	Y	Y	Area rug, DO, PF
104	1301	ND	72	15	5	ND	18	Y 0/2	Y	N	Portable AC, DO, items on UV
105 Music	1333	ND	70	16	8	ND	2	Y 0/3	Y	Y	Items on UV, area rug, PF
106	1334	ND	72	15	3	ND	20	Y 0/3	Y	Y	CP, area rug

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Location: Lt. Hansen Elementary School

Address: 25 Pecunit Street, Canton, MA

Indoor Air Results

Date: 1/26/2018

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	TVOCs (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
107	1376	ND	72	16	4	ND	17	Y 0/3	Y	Y	Area rug, items on/front UV and exhaust unit
108	1400	ND	72	15	6	ND	20	Y 0/3	Y	Y	Items on UV
109	1173	ND	71	14	4	ND	20	Y 0/3	Y	Y	WD CTs along inside wall, items on UV and exhaust unit, area rug
110	1477	ND	74	16	4	ND	19	Y 0/2	Y	Y	Portable AC, "black debris" reported from UV, fiberglass insulation in UV cabinet, urine odors reported in bathroom-weak exhaust, floor drain
111	983	ND	74	14	4	ND	1	Y 1/3	Y	Y	16 occupants gone~ 30 mins
112	908	ND	71	10	4	ND	20	Y 0/4	Y	Y	Area rug
113	771	ND	70	9	5	ND	15	Y 0/4	Y	Y	Area rug, exhaust near door, DO, occupants just left for lunch

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TVOCs = total volatile organic compounds

UV = univent

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Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lt. Hansen Elementary School

Address: 25 Pecunit Street, Canton, MA

Indoor Air Results

Date: 1/26/2018

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	TVOCs (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
114	987	ND	70	12	4	ND	17	Y 0/4	Y	Y	Area rug, exhaust near door, DO
115	823	ND	72	10	6	ND	22	Y 0/4	Y	Y	Area rug, exhaust near door, DO, 3 WD CTs
Nurse's Office	963	ND	77	12	4	ND	2	Y 0/3	Y	Y	Wall AC
Martin	1108	ND	75	12	4	ND	22	Y 0/2	Y	N	
Cafeteria	1099	ND	71	15	6	ND	0	N	Y	Y	
Gym	1331	ND	69	23	10	ND	20	N	Y	Y	Ventilation not operating
Gym Office	1312	ND	69	23	8	ND	1	N	N	Y	Exhaust not operating, occasional odors/fumes from gas-powered/lawn equipment
Conference Room	1108	ND	71	18	3	ND	1	N	Y	Y	2 WD CT
Main Office	1055	ND	71	15	6	ND	2	N	Y	Y	Carpet

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Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Lt. Hansen Elementary School

Address: 25 Pecunit Street, Canton, MA

Indoor Air Results

Date: 1/26/2018

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	TVOCs (ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
Copy Room	1211	ND	73	17	8	ND	1	N	N	Y	Dust/debris accumulation on vent-remove to clean
Library Office	1036	ND	73	16	4	ND	3	N	Y Passive	Y	
Doherty	947	ND	77	16	7	ND	0	N	Y Passive	Y	
Teacher's Workroom	1302	ND	76	17	7	ND	0	Y 0/3	Y	Y	UV-off, lamination machine
Kaplan	1028	ND	75	12	5	ND	1	N	Y	Y	
Library	942	ND	73	11	5	ND	18	Y 0/3	Y	Y	Portable AC, carpet squares, plants
Test Room	925	ND	73	11	5	ND	1	N	Y	Y	Carpet, DO

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AC = air conditioner

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CT = ceiling tile

DO = door open

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> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

APPENDIX A

Risk Factor Information for Breast Cancer

How to Use this Factsheet

This risk factor summary was developed to serve as a general fact sheet. It is an overview and should not be considered exhaustive. For more information on other possible risk factors and health effects being researched, please see the References section.

A risk factor is anything that increases a person's chance of developing cancer. Some risk factors can be controlled while others cannot. Risk factors can include *hereditary conditions, medical conditions or treatments, infections, lifestyle factors, or environmental exposures*. Although risk factors can influence the development of cancer, most do not directly cause cancer. An individual's risk for developing cancer may change over time due to many factors, and it is likely that multiple risk factors influence the development of most cancers. Knowing the risk factors that apply to specific concerns and discussing them with your health care provider can help to make more informed lifestyle and health care decisions.

For those cancer types with environmentally-related risk factors, an important factor in evaluating cancer risk is the route of exposure. This is particularly relevant when considering exposures to chemicals in the environment. For example, a particular chemical may have the potential to cause cancer if it is inhaled, but that same chemical may not increase the risk of cancer through skin contact. In addition, the dose and duration of time one might be exposed to an environmental agent is important in considering whether an adverse health effect could occur.

Gene-environment interactions are another important area of cancer research. An individual's risk of developing cancer may depend on a complex interaction between their genetic makeup and exposure to an environmental agent (for example, a virus or a chemical contaminant). This may explain why some individuals have a fairly low risk of developing cancer as a result of an environmental factor or exposure, while others may be more vulnerable.

Key Statistics

Breast cancer is the most frequently diagnosed cancer among women in the United States, except for skin cancers. The American Cancer Society estimates that in 2015, approximately 231,840 women in the U.S. and 5,890 women in Massachusetts will be diagnosed with breast cancer. The disease is expected to account for approximately 29% of all new cancer diagnoses in females.¹ Between 2007 and 2011, invasive breast cancer accounted for 29.0% of cancer diagnoses in females in Massachusetts.¹¹

In the United States, breast cancer rates stabilized in the early 1990s, increased in the latter half of the 1990s, and dropped sharply between 2002 and 2003. The sharp drop has been attributed to decreased use of menopausal hormones following the 2002 publication of the Women's Health Initiative study results. This study linked the use of

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hormone therapy to an increased risk of breast cancer.² In Massachusetts, the incidence of invasive breast cancer in females remained stable over the years 2007-2011.¹¹

The chance of developing invasive breast cancer at some time in a woman's life is about 1 in 8. Women are 100 times more likely than men to develop this disease.² Men can also develop breast cancer, but male breast cancer is rare, accounting for 1% of all breast cancer cases.^{1,9} For more information on breast cancer in men, visit the American Cancer Society website at www.cancer.org.⁵

A woman's risk of developing breast cancer increases with age. About 12-13% of invasive breast cancers are found in women younger than 45, while about 66% are found in women age 55 or older. White women are slightly more likely to develop breast cancer than women of other races and ethnicities.²

Types of Breast Cancer

The term "cancer" is used to describe a variety of diseases associated with abnormal cell and tissue growth. Cancers are classified by the location in the body where the disease originated (the primary site) and the tissue or cell type of the cancer (histology).

There are several types of breast cancer, although some of them are quite rare. In some cases a single breast tumor can have a combination of these types or have a mixture of invasive and *in situ* cancer.

In situ breast cancers are considered the earliest stage of cancer, when it is confined to the layer of cells where it began. They have not invaded into deeper tissues in the breast or spread to other organs in the body, and are sometimes referred to as non-invasive breast cancers.² The remainder of this risk factor summary pertains to invasive breast cancers. Additional information on *in situ* breast cancers and other benign breast conditions can be found at www.cancer.org (American Cancer Society).³

An invasive, or infiltrating, cancer is one that has already grown beyond the layer of cells where it started (as opposed to carcinoma *in situ*). Most breast cancers are invasive carcinomas – either invasive ductal carcinoma or invasive lobular carcinoma.²

Breast cancer most commonly involves either the milk-producing lobules or the tubular ducts that connect the lobules to the nipple.⁶ Roughly 80% of all breast cancers originate in the ducts, and are known as invasive ductal carcinoma (IDC). An additional 10% begin in the lobules, and are known as invasive lobular carcinoma (ILC). Invasive lobular carcinoma may be harder to detect by a mammogram than invasive ductal carcinoma. Both types of cancer can spread (metastasize) from the original site to other parts of the body.^{2,6}

Other less common types of invasive breast cancer² include:

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- inflammatory breast cancer
- triple-negative breast cancer
- medullary carcinoma
- metaplastic carcinoma
- mucinous carcinoma
- Paget's disease
- tubular carcinoma
- papillary carcinoma
- Phyllodes tumor
- adenoid cystic carcinoma or adenocystic carcinoma
- angiosarcoma

Established Risk Factors

Hereditary Conditions

Having a family history of breast cancer increases a woman's risk of developing the disease. Women who have a first-degree relative (i.e., mother, sister) with breast cancer have about twice the risk of developing breast cancer themselves. Having two first-degree relatives with this disease increases a woman's risk by three- to five-fold.^{2, 6} The risk is also elevated if several close relatives from either side of the family have been diagnosed with breast or ovarian cancer, especially before age 50.^{6, 13} Overall, less than 15% of women with breast cancer have a family member with the same disease. Therefore, over 85% of women who have breast cancer have no familial link to the disease.²

About 5-10% of breast cancer diagnoses are thought to be due to an inherited genetic mutation.^{2, 15} Most of these mutations occur in the *BRCA1* and *BRCA2* genes. Other genes that may lead to an increased risk for developing breast cancer include *ATM*, *CHEK2*, *TP53* and *PTEN*. Women who inherit these gene mutations have up to an 80% chance of developing breast cancer during their lifetime.²

Medical Conditions and Treatments

Certain benign breast conditions may increase one's risk for breast cancer. Women with proliferative lesions without atypia (i.e., abnormal or unusual cells), which have excessive growth of cells in the ducts or lobules of breast tissue, are 1.5 to 2 times more likely to develop breast cancer compared with women who have non-proliferative lesions.¹⁵ Proliferative lesions with atypia, when the cells are excessively growing and no longer appear normal, raise one's risk by 3.5 to 5 times. Women with denser breast tissue (as seen on a mammogram) have more glandular tissue and less fatty tissue, and have a higher risk of breast cancer.²

A woman with cancer in one breast is 3 to 4 times more likely to develop a new cancer in the other breast or in another part of the same breast. In addition, a previous diagnosis of an *in situ* breast cancer puts a woman at increased risk for an invasive breast cancer.²

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Risk Factor Information for Breast Cancer

Cumulative exposure of the breast tissue to estrogen is associated with breast cancer risk. Several factors can influence estrogen levels. Women who started menstruating at an early age (before age 12) and/or went through menopause at a later age (after age 55) have a slightly higher risk of breast cancer. Also, women who have had no children or those whose first pregnancy occurred when they were over the age of 30 have an increased risk for developing breast cancer.² Women who have had more children and those who have breast-fed seem to be at lower risk.¹⁵

Use of hormone replacement therapy is another factor that may affect breast cancer risk. Long-term use (several years or more) of combined post-menopausal hormone therapy (PHT) increases the risk of breast cancer. The increased risk from combined PHT appears to apply only to current and recent users. A woman's breast cancer risk seems to return to that of the general population within 5 years of stopping combined PHT. The use of estrogen-only replacement therapy (ERT) does not appear to increase the risk of breast cancer significantly but when used long-term (for more than 10 years), ERT has been found to increase the risk of ovarian cancer in some studies.^{2, 15}

Women who had radiation therapy to the chest area as treatment for another cancer (i.e., ionizing radiation for Hodgkin disease) are at significantly increased risk for breast cancer.¹⁵ This risk appears to be highest if the radiation is given during adolescence or puberty, when the individual's breasts are developing.²

From the 1940s through the 1960s some pregnant women were given the drug diethylstilbestrol (DES) because it was thought to lower their chances of miscarriage. These women have a slightly increased risk of developing breast cancer. A woman whose mother took DES while pregnant may also have a slightly higher risk of breast cancer.²

Lifestyle Factors

Alcohol consumption has also been associated with increased risk for breast cancer. Compared with non-drinkers, women who consume one alcoholic drink a day have a very small increase in risk whereas those who have 2 to 5 drinks daily have about 1½ times the risk of women who drink no alcohol.²

Possible Risk Factors

Environmental Exposures

A great deal of research has been reported and more is being done to understand possible environmental influences on breast cancer risk. Of special interest are compounds in the environment that have been found in animal studies to have estrogen-like properties, which could in theory affect breast cancer risk. For example, substances found in some plastics, certain cosmetics and personal care products, pesticides (such as DDE), and PCBs (polychlorinated

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biphenyls) seem to have such properties. To date, however, there is not a clear link between breast cancer risk and exposure to these substances.²

Lifestyle Factors

For a long time, the role of cigarette smoking in the development of breast cancer was unclear. Recent research, however, supports a consistent association between smoking and an increased risk of breast cancer, with long-term heavy smokers at highest risk.^{16, 2}

Some studies suggest a relationship between secondhand smoking and an increased risk for breast cancer; however, confirming this relationship has been difficult and is still the subject of active research.^{2, 15, 16}

Recent studies have indicated that being overweight or obese after menopause may put a woman at increased risk of breast cancer.^{2, 6, 15} Similarly, women who are physically inactive throughout life may have an increased risk of breast cancer.²

Studies have found that women using oral contraceptives (birth control pills) have a slightly greater risk of breast cancer than women who have never used them, but this risk seems to decline once their use is stopped. Women who stopped using oral contraceptives for more than 10 years do not appear to have any increased breast cancer risk. When thinking about using oral contraceptives, women should discuss their other risk factors for breast cancer with their physician.²

Lifetime risk of breast cancer is increased in women of higher socioeconomic status (SES) (e.g. income, education). Research suggests that this may be due to reproductive and lifestyle factors (age at first full-term birth, physical activity, diet, cultural practices, etc.).^{6, 15}

Several recent studies have also suggested that working the night shift may be associated with an increased risk of breast cancer. The light-sensitive hormone melatonin may play a role in this link, and further research is being conducted in this area.^{2, 10}

Other Risk Factors That Have Been Investigated

Lifestyle Factors

Though links have been suggested, antiperspirants, bras, and breast implants have all been investigated as possible risk factors for breast cancer but no associations have been found.^{2, 15}

Dietary fat intake is another factor that has been suggested to increase a woman's risk for breast cancer. Though studies have found decreased breast cancer rates in countries with a diet typically lower in fat, studies in the U.S. have not shown an association between the amount of fat in the diet and increased risk of breast cancer.^{2, 15}

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Risk Factor Information for Breast Cancer

References/For More Information

Much of the information contained in this summary has been taken directly from the following sources. This material is provided for informational purposes only and should not be considered as medical advice. Persons with questions regarding a specific medical problem or condition should consult their physician.

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